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Monitoring the Ar-plasma pre-melting of fluxed Cr2O3 and iron oxides in a lab-scale electric arc furnace

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Natural chromite ores can be classified into high-grade, sub-grade and low-grade chromium ore regarding the concentration of Cr2O3. All categories of chromium ores are available for ferroalloy production. Around 80%-90% of ferrochrome (FeCr) which yields from the energy intensive carbothermic smelting of chromium ore is consumed by the production of stainless steel. Stainless steel is widely used in various applications including construction, automotive, aerospace, and kitchenware. A fundamental study on recognizing the impact of common fluxes on the formation of desired and undesired spinels in interaction with Cr2O3 is required. It is due to the modifying the melting behavior of synthetic chromite in the smelting process via electric arc furnace (EAF). CaO and SiO2 are two common fluxes in the chromite smelting process to lower the melting point of Cr2O3 and increase the efficiency of reduction process.

In this work, the pre-melting of fluxed Cr2O3 and iron oxides are studied by self-developed lab-scale EAF in an argon atmosphere. Besides that, investigating the interaction between slag/oxides and crucible in high temperature, which is made from refractory material MgO, has also been analyzed. The melting process is monitored by optical emission spectroscopy (OES) coupled with camera to record the reactions during the melting. The OES focuses on analyzing plasma composition, presenting how the intensities of different elements evolve as the function of time, and evaluating plasma characteristics. The plasma video will provide a direct look into the reactor, i.e. the dynamic behavior of plasma arc, the status of molten bath and crucible, the filtered pixel intensities from the extracted plasma images. Energy consumption will also be considered for further optimization of energy saving.

With the help of OES in-situ monitoring in EAF, the melting properties of chromite ore can be better understood by initially studying synthetic chromite (Cr2O3-Iron Oxides-CaO-SiO2) system and adjusting to different slag basicities. Optimal mixtures can then be approached and identified in future studies.

Speaker Country

Finland

Speaker Company/University

University of Oulu

Primary author: Ms SUN, Yuhan (University of Oulu)

Co-authors: Dr PAUNA, Henri (University of Oulu); Mr HAURU, Matias (University of Oulu); Mr JAFARZADEH, Mohammad (K1-MET GmBH); Prof. FABRITIUS, Timo (University of Oulu); Mr KOKKONEN, Tommi

(University of Oulu)

Presenter: Ms SUN, Yuhan (University of Oulu)

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